



DEPARTMENT OF THE NAVY

ENGINEERING FIELD ACTIVITY, NORTHEAST
NAVAL FACILITIES ENGINEERING COMMAND

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November 12, 2003

Ms. Christine Williams
U.S. Environmental Protection Agency, Region I
1 Congress Street Suite 1100 (HBT)
Boston, MA 02114-2023

Mr. Richard Gottlieb
Office of Waste Management
Rhode Island Department of Environmental Management
235 Promenade Street
Providence, RI 02908-5767

Dear Ms. Williams/Mr. Gottlieb:

SUBJECT: SITE 16 HYDROGEOLOGICAL CONCERNS, NCBC DAVISVILLE,
NORTH KINGSTOWN, RI

Enclosed is the Navy's evaluation of the concerns presented
by EPA at the September 11, 2003 BCT meeting.

The Navy suggests a technical meeting if additional
discussion is necessary on this issue.

If additional information is required, please contact Mr.
Fred Evans at 610-595-0567, extension 159.

Sincerely,

FREDERICK J. EVANS

Remedial Project Manager
By direction of the
Commanding Officer

Copy to:

ToNK (Marilyn Cohen)

ToNK (Susan Licardi)

RIEDC (Steve King)

CSO Davisville (Dave Barney)

EA Engineering (Jim Shultz)

USDC, NOAA, NMR Branch (Dr. Kenneth Finkelstein)

NE Field Office, US Fish & Wildlife (Mr. Kenneth Carr)

**EVALUATION OF EPA NEW ENGLAND'S CONCERNS
FOR
SITE 16, CREOSOTE DIP TANK SPILL
DRAFT PHASE II INVESTIGATION REPORT**

GENERAL

At the 11 September 2003 BCT Meeting, EPA presented 2 key lines of evidence and hydraulic mechanism, bedrock groundwater pH and vertical hydraulic gradient, for connection of the deep dissolved CVOC plume at the former Nike Site and that detected beneath the former Building 41 portion of the Site 16 investigation area.

Since the 11 September 2003 meeting, the Navy has reviewed the EPA data presented regarding the 2 key lines of evidence and hydraulic mechanism for connection of the deep dissolved CVOC plume at the former Nike Site and that detected beneath the former Building 41 portion of the Site 16 investigation area.

1. VERTICAL HYDRAULIC GRADIENT

Table 3-4 (Summary of Vertical Hydraulic Gradient Data) in the draft Site 16 Phase II Investigation report was calculated from only the November 2002 and March/April 2003 water level measurements from which the area-wide (from adjacent to the former Nike Site and east through Site 16) ground-water surface contour maps were prepared. These were the only two comprehensive sets of depth to ground-water measurements available that included both areas and these data were then used to calculate the vertical hydraulic gradients for the Draft Site 16 Phase II Investigation Report. The historical water level and vertical hydraulic gradient data for the former Nike Site and Navy Sites 02 and 03 have since been added and a revised Table 3-4 prepared (Attachment 1). Additionally, an error was identified in the calculation of the July 2000 data, which has been corrected in the revised Table 3-4.

These vertical hydraulic gradient data from the revised Table 3-4 have been illustrated on Figures 1 through 5 (Attachment 2) for 5 ground-water zone monitoring well pairs (shallow (S) and intermediate (I) overburden, intermediate (I) and deep (D) overburden, shallow (S) and deep (D) overburden, deep (D) overburden and upper competent bedrock (R), and upper competent bedrock (R), and deeper competent bedrock (R2), respectively). Tags (dots) similar to those that appeared to be used for each well in EPA's presentation figure have been used here; i.e., red for upward vertical gradient and blue for downward vertical gradient for all data of an individual well pair, plus the addition of yellow dots for variable vertical gradient where both upward and downward vertical gradients were observed for an individual well. The yellow dots are well pairs with data indicating 50% upward and 50% downward vertical hydraulic gradients unless otherwise noted on a figure for the majority direction; e.g., "3/5 Upward". Figures 1 and 2 include only wells installed for the Site 16 investigation because that is the only portion of the subject area where intermediate (I) depth wells have been installed. As shown on the revised Table 3-4, the dates of the data illustrated on Figures 3 through 5 range considerably for the Site 03 and former PR-58 Nike Site areas (1994 to 2003; but data for all dates are not available for every well) as compared to the Site 16 data (2000 to 2003). Figure 3 is for wells pairs completed in the shallow and deep overburden and indicates that many of these wells show downward vertical gradients at both the extended Site 03 area (eastern portion) and the Site 16 area. However, there are a large number of these well pairs with variable and upward vertical gradients. There is no related data available for the former Nike Site area, nor the western portion of the Navy's Site 03. Of particular interest is the data shown on Figure 4 for the deep overburden/upper bedrock well pairs which shows that at the former Nike Site in the area of high CVOC

detections just east of the former Nike missile area (MW03-14) and due east (laterally downgradient at MW03-12 and MW03-13) at the edge of the former Nike Site near SeaBee Avenue, the vertical gradients are variable with a majority being downward. Additionally, at EA-104R where the total CVOC concentration in the September 2000 sample was 5,201 $\mu\text{g/L}$, the vertical gradient is upward. For the next approximately 1,000 ft east-southeastward across the western portion of the Navy property, the vertical gradients are variable with a majority being upward. This does not fully support the EPA's interpretation that the elevated CVOC in deep ground water at the former Nike Site is driven deep beneath the Site 03 monitoring wells constructed in the upper portion of competent bedrock (R) resulting in a reason why the CVOC was not detected there; e.g., EA-111R located west of Liberty Avenue. East from this area to the Building 41 and Site 16 area, Figure 4 shows a majority of downward vertical gradients with only a variable (though majority upward) gradient for MW16-15D/R (northeast end of former Building 41). Based on the available data, a downward vertical gradient is observed for approximately 70% of the 14 D/R well pairs in the Site 16 investigation area (Figure 4). Figure 5 illustrates the data for wells completed in the upper and deeper portions of competent bedrock (R and R2, respectively). Figure 5 shows that although the vertical gradient is downward at the well where the highest CVOC concentrations have been detected at the former Nike Site (westmost dot on the Figure), the vertical gradient is also downward at the northeast end of the former Building 41 (Site 16) which would not support the upward flow in this area of a deep CVOC plume from the west.

Lastly, the only upward vertical gradient observed for the R/R2 well pairs is at Site 16 (MW16-02R/R2) (Figure 5). However, the vertical gradient for the overlying zone (MW16-02D/R) is downward (Figure 4), suggesting lateral ground-water flow along the silty gravelly sandy overburden and the weathered or fractured bedrock interface.

Based on the above review of all the available vertical hydraulic gradient data, the Navy does not agree these data support a key hydraulic mechanism and evidence for the CVOC plume detected in deep ground water beneath the Nike Site to be driven to depths deeper into bedrock (deeper than the upper bedrock zone monitoring wells located in the Navy's Site 03 area between the Nike Site and Site 16 where a trace to no total CVOC is detected), and then, returned back up into the upper bedrock and deep overburden zones in the former Building 41 portion of the Site 16 investigation area.

GROUNDWATER pH

The related field measured pH data is illustrated in Figures 6-10 of Attachment 2. As shown on Figures 6 and 9, there are 22 monitoring wells where $\text{pH} > 8$ has been measured at least once. These wells are located across the large investigation area and not just along a line between the former Nike Site and Site 16. Most of these wells are completed in competent bedrock with steel casing bentonite-cement grouted in place down to the open or screened portion of the well. There is a good potential for a minor amount of the grout to have migrated into naturally present fractures in the rock near the top of the open or screened interval and which caused the elevated pH measured during sampling. As monitoring wells are not regularly pumped and are sampled (purged) perhaps once per year or less, this limited activity has apparently not removed ground water near the well with the elevated pH. However, for these sites, VOCs are the main analytes of concern, not dissolved metals; therefore, the locally elevated pH should not negatively affect groundwater samples collected for VOC analysis. Additionally, sampling (including pH measurement) has occurred only once at 16 (73%) of these wells, and it occurred not long after well installation and development. For an additional 4 (18%) of these wells, a $\text{pH} > 8$ was recorded for only one of the 2 to 4 measurements performed. For the remaining 2 wells (EA-110R and MW16-23D), the recorded pH has been > 8 for each of the 4 and 2 measurements, respectively. Figures 8 and 10 (Cross

Sections C-C' and I-I', respectively) further illustrate the pH data available for wells located along the path between the former Nike Site and Site 16. Figure 7 (Cross Section B-B') begins in the vicinity of the former acid neutralization pit (near EA-108D/R and EA-114D/R) at the former Nike Site and shows that the recorded pH values for those wells are <7 . Additionally as shown on Figure 6, there are no pH values >8 measured for the wells located immediately around Building 224, and particularly just southwest of that building where Site 02 was located.

Based on review of these data, the Navy does not agree that the pH data are a surrogate for and evidence of CVOC migration from the former Nike Site and connection with the CVOC plume area detected at Site 16, Building 41 area, located more than 3,700 ft east-southeast of the former Nike Site.

Attachment 1

TABLE 3-4 SUMMARY OF VERTICAL HYDRAULIC GRADIENTS

Well Cluster	Date	Vertical Distance*	Head Difference**	Gradient***
MW16-01S/D	10/04/00	32.52	0.45	1.38E-02
	03/29/01	35.15	0.08	2.28E-03
	05/02/01	35.21	0.00	0.00E+00
	03/25/03	34.02	0.25	7.35E-03
MW16-02S/D	10/04/00	51.54	-1.15	-2.23E-02
	03/29/01	53.86	-1.73	-3.21E-02
	05/02/01	54.01	-1.95	-3.61E-02
	03/25/03	52.9	-1.63	-3.08E-02
MW16-03S/D	10/04/00	40.67	-1.79	-4.40E-02
	03/29/01	42.24	-2.96	-7.01E-02
	05/02/01	41.39	-0.24	-5.80E-03
	11/20/02	40.48	-1.81	-4.47E-02
	03/25/03	41.7	-2.18	-5.23E-02
MW16-04S/D	10/04/00	43.16	-1.27	-2.94E-02
	03/29/01	44.5	-2.57	-5.78E-02
	05/02/01	43.59	-2.29	-5.25E-02
	11/20/02	43.51	-2.01	-4.62E-02
	03/25/03	45.25	-3.09	-6.83E-02
MW16-05S/D	05/02/01	37.53	-1.56	-4.16E-02
	03/25/03	37.42	-0.87	-2.32E-02
MW16-06S/D	10/04/00	27.76	0.60	2.16E-02
	03/29/01	30.68	0.31	1.01E-02
	05/02/01	29.87	0.57	1.91E-02
	03/25/03	29.88	0.26	8.70E-03
MW16-07S/D 3/5 upwards	10/04/00	24.44	0.04	1.64E-03
	03/29/01	27.19	-0.09	-3.31E-03
	05/02/01	26.41	0.03	1.14E-03
	11/20/02	23.76	0.02	8.42E-04
	03/25/03	26.36	-0.08	-3.03E-03
MW16-11 S/D	11/20/02	44.51	-0.62	-1.39E-02
	03/25/03	45.27	-0.07	-1.55E-03
MW16-17 S/D	11/20/02	52.63	-0.93	-1.77E-02
	03/25/03	53.71	-0.42	-7.82E-03
MW16-33 S/D	11/20/02	NA	NA	NA
	03/25/03	NA	NA	NA
MW16-34 S/D	11/20/02	NA	NA	NA
	03/25/03	NA	NA	NA
MW16-35 S/D	11/20/02	46.85	-0.56	-1.20E-02
	03/25/03	48.03	-0.17	-3.54E-03

NOTES: Highlighting of MW designation: Red is for upward vertical gradient, Blue is for downward, and Yellow is for well with variably both upward and downward vertical gradients.

* = Distance between the water level elevation in the shallower monitoring well and the middle of the screened interval in the deeper monitoring well.

** = Difference in the water level elevation in shallower monitoring well and deeper monitoring well.

*** = Positive value indicates an upward component of ground-water flow to the shallower interval from the deeper interval. Negative value indicates a downward component of ground-water flow from the shallower interval to the deeper interval. Zero value indicates no apparent vertical component of ground-water flow between the two depth intervals.

NA = Not analyzed because the depth to water in the shallow (S) well was below the top of the dedicated in-well sampling pump and could not be obtained (measured).

Well Cluster	Date	Vertical Distance*	Head Difference**	Gradient***
MW16-37 S/D	11/20/02	36.62	1.29	3.52E-02
	03/25/03	39.90	-0.37	-9.27E-03
MW16-41 S/D	11/20/02	44.95	0.41	9.12E-03
	03/25/03	48.34	-0.67	-1.39E-02
MW16-42 S/D	11/20/02	54.42	-2.44	-4.48E-02
	03/25/03	57.34	-4.01	-6.99E-02
MW16-43 S/D	11/20/02	33.00	-1.23	-3.73E-02
	03/25/03	35.39	-1.78	-5.03E-02
MW16-44 S/D	11/20/02	47.63	-2.96	-6.21E-02
	03/25/03	50.12	-2.82	-5.63E-02
MW16-45 S/D	11/20/02	46.21	0.09	1.95E-03
	03/25/03	48.87	-1.10	-2.25E-02
MW16-46 S/D	11/20/02	47.77	-1.26	-2.64E-02
	03/25/03	49.39	-1.85	-3.75E-02
MW16-47 S/D	11/20/02	24.10	-0.27	-1.12E-02
	03/25/03	26.29	-0.08	-3.04E-03
MW16-48 S/D	11/20/02	36.28	0.18	4.96E-03
	03/25/03	36.10	1.19	3.30E-02
RMW 01 S/D 5/6 down	05/31/95	38.37	-0.65	-1.69E-02
	10/03/95	35.84	-0.19	-5.30E-03
	11/17/95	37.45	-0.2	-5.34E-03
	7/27/00	37.75	-0.30	-7.95E-03
	11/20/02	34.39	0.16	4.65E-03
	03/25/03	36.38	-0.28	-7.70E-03
RMW 02 S/D	05/31/95	17.99	0.07	3.89E-03
	10/03/95	15.32	0.09	5.88E-03
	11/20/02	18.47	-0.21	-1.14E-02
	03/25/03	20.24	-0.19	-9.39E-03
RMW 03 S/D	05/31/95	26.93	0.48	1.78E-02
	10/03/95	23.99	-0.12	-5.00E-03
	11/20/02	25.20	-1.11	-4.40E-02
	03/25/03	25.37	0.27	1.06E-02
PGU-Z3-03 S/D	11/20/02	54.11	-0.81	-1.50E-02
	03/25/03	53.75	0.51	9.49E-03
PGU-Z3-07 S/D	11/20/02	29.73	0.05	1.68E-03
	03/25/03	30.94	0.00	0.00E+00
PGU-Z3-09 S/D	11/20/02	31.51	-0.88	-2.79E-02
	03/25/03	34.21	-1.51	-4.41E-02
PGU-Z3-10 S/D	11/20/02	46.24	0.09	1.95E-03
	03/25/03	48.12	-0.43	-8.94E-03
PGU-Z4-03 S/D	11/20/02	43.21	-0.07	-1.71E-03
	03/25/03	44.91	-0.18	-4.01E-03
PGU-Z4-04 S/D	11/20/02	48.19	0.34	7.06E-03
	03/25/03	48.43	0.65	1.34E-02
MW01-10 S/D	11/17/95	53.8	-0.11	-2.04E-03
	12/97	54.28	-0.26	-4.79E-03
	7/26/00	57.09	-0.59	-1.03E-02
	11/20/02	53.84	-0.10	-1.86E-03
	03/25/03	58.18	-0.27	-4.64E-03

Well Cluster	Date	Vertical Distance*	Head Difference**	Gradient***
MW01-12 S/D 2/3 upward	11/17/95	30.99	0.04	1.29E-03
	12/97	31.23	0.09	2.88E-03
	7/26/00	33.30	-0.12	-3.60E-03
MW01-13 S/D	11/17/95	54.33	1.56	2.87E-02
	12/97	54.46	1.56	2.86E-02
	7/26/00	54.66	2.34	4.28E-02
	11/20/02	54.15	1.88	3.47E-02
	03/25/03	56.28	1.77	3.14E-02
MW01-14 S/D	11/17/95	61.98	0.55	8.87E-03
	12/97	62.18	0.44	7.08E-03
	7/26/00	62.78	0.73	1.16E-02
	11/20/02	62.05	0.60	9.67E-03
	03/25/03	63.69	0.89	1.40E-02
MW02-03 S/D 7/10 upward	04/26/94	15.49	0.04	2.58E-03
	12/01/94	12.43	0.05	4.02E-03
	04/27/95	14.3	0.02	1.40E-03
	06/02/95	14.26	0.02	1.40E-03
	10/03/95	12.38	0.04	3.23E-03
	11/17/95	12.07	0.46	3.81E-02
	12/97	12.86	-0.04	-3.11E-03
	7/27/00	14.43	0.27	1.87E-02
	11/20/02	12.58	-0.02	-1.59E-03
	03/25/03	14.71	-0.02	-1.36E-03
	04/26/94	22.91	-0.04	-1.75E-03
	12/01/94	19.06	-0.03	-1.57E-03
(wells destroyed during the Site 02 remedy removal action)	04/27/95	21.61	-0.06	-2.78E-03
	06/02/95	21.69	-0.08	-3.69E-03
	10/03/95	19.31	-0.05	-2.59E-03
	11/17/95	19.26	-0.03	-1.56E-03
	04/26/94	23.17	-0.25	-1.08E-02
MW02-08 S/D 9/10 down	12/01/94	19.49	0.09	4.62E-03
	04/27/95	21.84	-0.06	-2.75E-03
	06/02/95	21.92	-0.08	-3.65E-03
	10/03/95	19.74	-0.08	-4.05E-03
	11/17/95	19.65	-0.06	-3.05E-03
	12/97	20.05	-0.07	-3.49E-03
	07/27/00	22.18	-0.08	-3.61E-03
	11/20/02	19.86	-0.05	-2.52E-03
	03/25/03	22.26	-0.07	-3.14E-03
	04/26/94	30.11	-0.10	-3.32E-03
	12/01/94	26.59	-0.12	-4.51E-03
MW02-10S/D	04/27/95	28.83	-0.07	-2.43E-03
	06/02/95	28.89	-0.10	-3.46E-03
	10/03/95	26.80	-0.09	-3.36E-03
	11/17/95	26.76	-0.06	-2.24E-03
	12/97	27.17	-0.08	-2.94E-03
	7/27/00	29.18	-0.09	-3.08E-03

Well Cluster	Date	Vertical Distance*	Head Difference**	Gradient***
MW02-11 S/D 8/9 upward	04/26/94	39.51	0.19	4.81E-03
	12/01/94	36.22	0.18	4.97E-03
	04/27/95	38.25	0.22	5.75E-03
	06/02/95	38.26	0.2	5.23E-03
	10/03/95	36.41	0.15	4.12E-03
	11/17/95	36.34	0.2	5.50E-03
	7/27/00	38.57	0.14	3.63E-03
	11/20/02	36.56	0.19	5.20E-03
	03/25/03	40.42	-1.65	-4.08E-02
MW03-02 S/D 8/9 down	04/26/94	40.45	-0.01	-2.472E-04
	12/01/94	36.2	0.02	5.525E-04
	04/27/95	39.18	-0.04	-1.021E-03
	06/02/95	39.17	-0.07	-1.787E-03
	10/03/95	36.56	-0.09	-2.462E-03
	11/17/95	36.51	-0.05	-1.369E-03
	07/27/00	39.32	-0.11	-2.80E-03
	11/20/02	36.70	-0.10	-2.72E-03
	03/25/03	39.65	-0.03	-7.57E-04
MW03-03 S/D	04/26/94	39.38	-0.04	-1.02E-03
	12/01/94	35.22	-0.02	-5.68E-04
	04/27/95	38.13	-0.04	-1.05E-03
	06/02/95	38.09	-0.04	-1.05E-03
	10/03/95	35.46	-0.04	-1.13E-03
	11/17/95	35.49	-0.04	-1.13E-03
	12/97	35.98	-0.05	-1.39E-03
	7/26/00	38.31	-0.16	-4.18E-03
	11/20/02	35.84	-0.09	-2.51E-03
MW03-05S/D	03/25/03	38.49	-0.02	-5.20E-04
	04/26/94	24.41	-0.03	-1.23E-03
	12/01/94	20.50	-0.12	-5.85E-03
	04/27/95	23.16	-0.04	-1.73E-03
	06/02/95	23.17	-0.06	-2.59E-03
	10/03/95	20.73	-0.05	-2.41E-03
	11/17/95	20.70	-0.08	-3.86E-03
	12/97	21.22	-0.11	-5.18E-03
	7/27/00	23.32	-0.08	-3.43E-03
MW16-02 S/I	11/20/02	NA	NA	NA
	03/25/03	25.77	-1.83	-7.10E-02
MW16-04 S/I	11/20/02	22.84	-2.20	-9.63E-02
	03/25/03	24.58	-3.37	-1.37E-01
MW16-05 S/I	11/20/02	NA	NA	NA
	03/25/03	19.23	-1.80	-9.36E-02
MW16-17 S/I	11/20/02	24.44	-0.25	-1.02E-02
	03/25/03	25.52	-0.04	-1.57E-03
MW16-33 S/I	11/20/02	NA	NA	NA
	03/25/03	NA	NA	NA
MW16-34 S/I	11/20/02	NA	NA	NA
	03/25/03	NA	NA	NA
MW16-35 S/I	11/20/02	23.39	-0.33	-1.41E-02
	03/25/03	24.57	-0.13	-5.29E-03

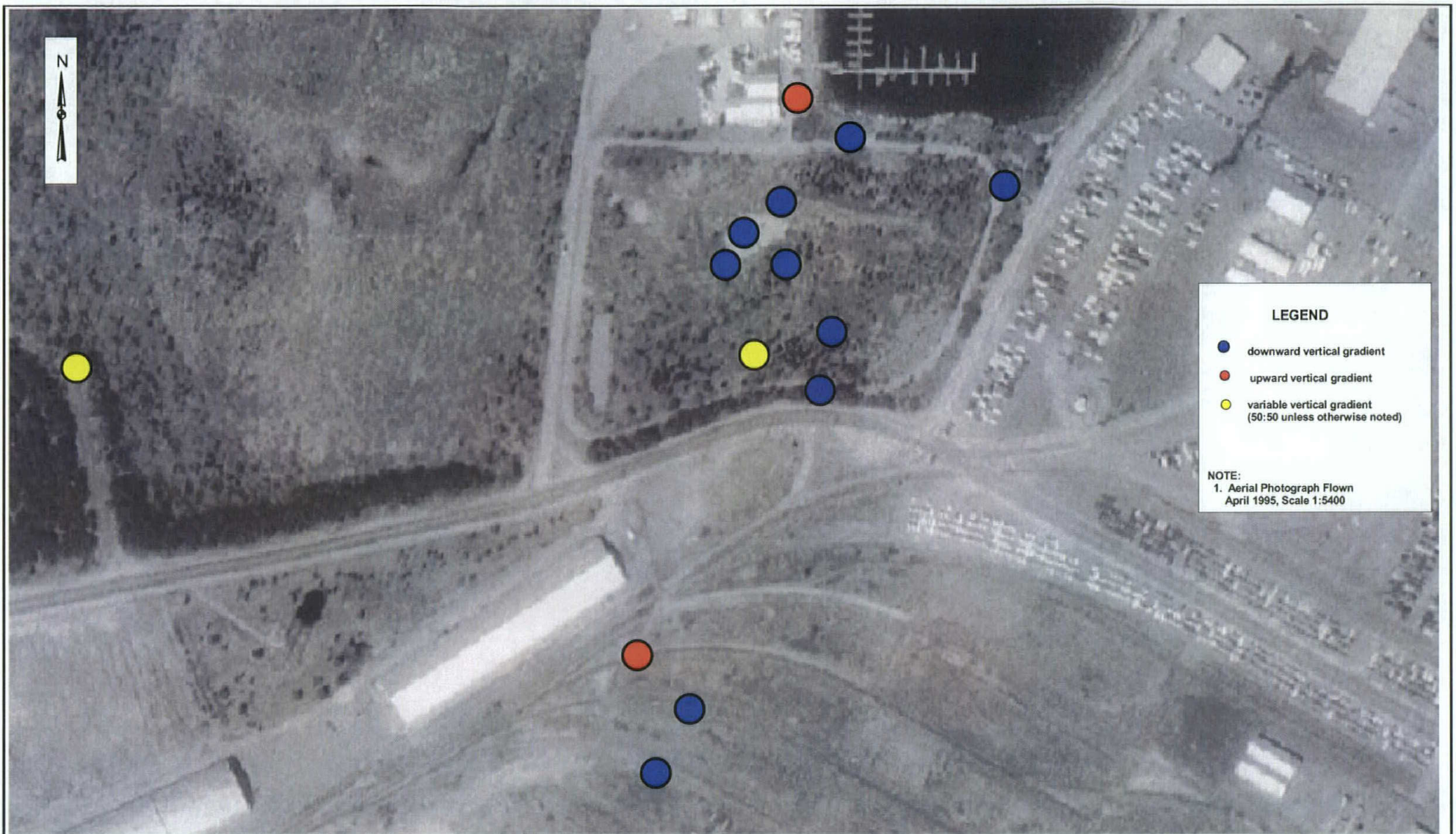
Well Cluster	Date	Vertical Distance*	Head Difference**	Gradient***
MW16-37 S/I	11/20/02	17.85	1.89	1.06E-01
	03/25/03	21.13	0.03	1.42E-03
MW16-41 S/I	11/20/02	13.30	0.12	9.02E-03
	03/25/03	16.69	-0.76	-4.55E-02
MW16-42 S/I	11/20/02	16.34	-2.36	-1.44E-01
	03/25/03	19.26	-3.76	-1.95E-01
MW16-43 S/I	11/20/02	42.52	-0.95	-2.23E-02
	03/25/03	44.91	-1.44	-3.21E-02
MW16-44 S/I	11/20/02	21.51	-1.84	-8.55E-02
	03/25/03	24.00	-2.82	-1.18E-01
MW16-45 S/I	11/20/02	45.45	-0.01	-2.20E-04
	03/25/03	48.11	-1.17	-2.43E-02
MW16-46 S/I	11/20/02	20.52	0.00	0.00E+00
	03/25/03	22.14	-0.24	-1.08E-02
MW16-48 S/I	11/20/02	20.92	0.64	3.06E-02
	03/25/03	20.74	1.69	8.15E-02
RMW01 S/I	11/20/02	15.19	0.10	6.58E-03
	03/25/03	17.18	-0.13	-7.57E-03
MW16-02 I/D	11/20/02	51.28	0.27	5.27E-03
	03/25/03	51.07	0.20	3.92E-03
MW16-04 I/D	11/20/02	41.31	0.19	4.60E-03
	03/25/03	41.88	0.28	6.69E-03
MW16-05 I/D	11/20/02	35.57	0.77	2.16E-02
	03/25/03	35.62	0.93	2.61E-02
MW16-13 I/D	11/20/02	47.73	-0.37	-7.75E-03
	03/25/03	48.95	-0.62	-1.27E-02
MW16-14 I/D	11/20/02	41.38	-0.83	-2.01E-02
	03/25/03	42.72	-0.53	-1.24E-02
MW16-16 I/D	11/20/02	48.12	-1.20	-2.49E-02
	03/25/03	49.82	0.00	0.00E+00
MW16-17 I/D	11/20/02	52.38	-0.68	-1.30E-02
	03/25/03	53.67	-0.38	-7.08E-03
MW16-18 I/D	11/20/02	37.55	-0.41	-1.09E-02
	03/25/03	39.21	-0.46	-1.17E-02
MW16-19 I/D	11/20/02	40.65	-0.13	-3.20E-03
	03/25/03	42.24	-0.13	-3.08E-03
MW16-20 I/D	11/20/02	35.80	-0.29	-8.10E-03
	03/25/03	38.07	-1.26	-3.31E-02
MW16-21 I/D	11/20/02	45.01	-0.45	-1.00E-02
	03/25/03	47.00	-0.46	-9.79E-03
MW16-22 I/D	11/20/02	38.01	0.46	1.21E-02
	03/25/03	40.38	0.40	9.91E-03
MW16-24 I/D	11/20/02	45.14	-0.72	-1.60E-02
	03/25/03	46.86	-0.56	-1.20E-02
MW16-25 I/D	11/20/02	41.84	-0.31	-7.41E-03
	03/25/03	43.65	-0.31	-7.10E-03
MW16-33 I/D	11/20/02	52.60	-0.22	-4.18E-03
	03/25/03	54.26	-0.32	-5.90E-03
MW16-34 I/D	11/20/02	39.17	-0.59	-1.51E-02
	03/25/03	40.49	-0.37	-9.14E-03

Well Cluster	Date	Vertical Distance*	Head Difference**	Gradient***
MW16-35 I/D	11/20/02	46.52	-0.23	-4.94E-03
	03/25/03	47.90	-0.04	-8.35E-04
MW16-37 I/D	11/20/02	38.51	-0.60	-1.56E-02
	03/25/03	39.93	-0.40	-1.00E-02
MW16-39 I/D	11/20/02	60.51	-0.15	-2.48E-03
	03/25/03	60.91	0.45	7.39E-03
MW16-41 I/D	11/20/02	45.07	0.29	6.43E-03
	03/25/03	47.58	0.09	1.89E-03
MW16-42 I/D	11/20/02	52.06	-0.08	-1.54E-03
	03/25/03	53.58	-0.25	-4.67E-03
MW16-43 I/D	11/20/02	32.05	-0.28	-8.74E-03
	03/25/03	33.95	-0.34	-1.00E-02
MW16-44 I/D	11/20/02	45.79	-1.12	-2.45E-02
	03/25/03	47.30	-1.31	-2.77E-02
MW16-45 I/D	11/20/02	46.20	0.10	2.16E-03
	03/25/03	47.70	0.07	1.47E-03
MW16-46 I/D	11/20/02	47.77	-1.26	-2.64E-02
	03/25/03	49.15	-1.61	-3.28E-02
MW16-48 I/D	11/20/02	36.92	-0.46	-1.25E-02
	03/25/03	37.79	-0.50	-1.32E-02
RMW01 I/D	11/20/02	34.49	0.06	1.74E-03
	03/25/03	36.25	-0.15	-4.14E-03
MW16-02D/R	03/29/01	72.9	-0.11	-1.51E-03
	05/02/01	72.83	-0.12	-1.65E-03
	11/20/02	70.2	-0.18	-2.56E-03
	03/25/03	72.04	-0.23	-3.19E-03
MW16-05 D/R	11/20/02	67.58	-0.02	-2.96E-04
	03/25/03	67.79	0.00	0.00E+00
MW16-06 D/R	11/20/02	47.26	-0.18	-3.81E-03
	03/25/03	49.69	-0.44	-8.85E-03
MW16-10D/R	05/02/01	62.15	-0.22	-3.54E-03
	11/20/02	62.44	-0.31	-4.96E-03
	03/25/03	63.9	-0.29	-4.54E-03
MW16-15D/R 2/3 upward	03/29/01	56.55	0.93	1.64E-02
	05/02/01	56.87	0.94	1.65E-02
	11/20/02	56.61	-0.03	-5.30E-04
	03/25/03	58.55	0.00	0.00E+00
MW16-17D/R	11/20/02	75.02	0.22	2.93E-03
	03/25/03	76.61	0.14	1.83E-03
MW16-25D/R	03/29/01	65.9	-0.49	-7.44E-03
	05/02/01	66.24	-0.44	-6.64E-03
	11/20/02	63.18	-0.23	-3.64E-03
	03/25/03	64.99	-0.38	-5.85E-03
MW16-27D/R ¾ upward	03/29/01	70.55	0.73	1.03E-02
	05/02/01	70.18	0.93	1.33E-02
	11/20/02	69.66	-0.27	-3.88E-03
	03/25/03	70.09	0.74	1.06E-02
MW16-28D/R	03/29/01	71.49	-0.04	-5.60E-04
	05/02/01	70.97	-0.02	-2.82E-04
	11/20/02	70.96	-0.02	-2.82E-04
	03/25/03	71.26	-0.10	-1.40E-03

Well Cluster	Date	Vertical Distance*	Head Difference**	Gradient***
MW16-36 D/R	11/20/02	57.64	-0.11	-1.91E-03
	03/25/03	58.94	-0.04	-6.79E-04
MW16-44 D/R	11/20/02	65.01	0.10	1.54E-03
	03/25/03	66.33	0.01	1.51E-04
MW16-51 D/R	11/20/02	80.88	-0.59	-7.29E-03
	03/25/03	80.98	-0.79	-9.76E-03
MW16-52 D/R	11/20/02	95.84	-0.86	-8.97E-03
	03/25/03	95.41	-0.35	-3.67E-03
MW16-55 D/R	11/20/02	94.06	-0.22	-2.34E-03
	03/25/03	95.27	-0.25	-2.62E-03
EA 104 D/R	04/18/03	57.43	1.12	1.95E-02
EA 106 D/R	2/98	60.56	0.19	3.14E-03
	07/26/00	56.82	-0.05	8.80E-04
	04/18/03	36.68	0.73	1.99E-02
EA-108D/R	7/26/00	23.81	-0.44	-1.85E-02
EA 110 D/R 3/5 down	02/01/98	80.92	-0.02	-2.47E-04
	07/28/00	79.44	0.97	1.22E-02
	11/14/01	78.54	-0.03	-3.82E-04
	11/20/02	79.53	0.02	2.51E-04
	03/25/03	80.42	-0.02	-2.49E-04
EA 111 D/R 3/5 upward	02/01/98	64.30	-0.12	-2.87E-03
	07/28/00	63.55	-0.23	-3.62E-03
	11/14/01	59.66	0.12	2.01E-03
	11/20/02	59.60	0.12	2.01E-03
	03/25/03	63.72	0.03	4.71E-04
EA 114 D/R	04/18/03	26.69	-0.07	-2.62E-03
MW01-10 D/R ¾ down	07/28/00	80.17	-0.28	-3.49E-03
	11/14/01	77.22	0.95	1.23E-02
	11/20/02	77.42	-0.04	-5.17E-04
	03/25/03	81.59	-0.38	-4.66E-03
MW01-13 D/R	11/20/02	78.51	0.75	9.55E-03
	03/25/03	80.53	0.73	9.06E-03
	7/26/00	79.48	0.77	9.69E-03
MW01-15 D/R	11/14/01	52.39	0.24	4.58E-03
	11/20/02	51.71	0.60	1.16E-02
	03/25/03	55.11	0.39	7.08E-03
MW02-03 D/R	07/27/00	36.91	0.07	1.90E-03
	11/14/01	35.28	0.63	1.79E-02
	11/20/02	34.77	0.66	1.90E-02
	03/25/03	36.90	0.60	1.63E-02
MW03-03 D/R ¾ upward	07/28/00	67.20	-0.15	-2.23E-03
	11/14/01	66.03	0.12	1.82E-03
	11/20/02	64.80	0.09	1.39E-03
	03/25/03	67.52	0.17	2.52E-03

Well Cluster	Date	Vertical Distance*	Head Difference**	Gradient***
MW03-08 D/R 6/8 upward	06/02/95	44.06	-0.05	-1.14E-03
	10/03/95	40.65	0.1	2.46E-03
	12/97	41.61	0.1	2.40E-03
	2/98	46.46	0.1	2.15E-03
	07/28/00	43.73	0.18	4.12E-03
	11/14/01	42.74	-0.86	-2.01E-02
	11/20/02	41.19	0.10	2.43E-03
	03/25/03	45.11	0.10	2.22E-03
MW03-12 D/R 5/7 down	06/02/95	39.86	-0.25	-6.27E-03
	10/03/95	36	-0.21	-5.83E-03
	07/18/96	39.57	-0.17	-4.30E-03
	12/97	36.49	0.36	9.87E-03
	2/98	41.53	-0.17	-4.09E-03
	7/26/00	39.07	0.33	8.45E-03
	04/18/03	42.43	-0.27	-6.36E-03
MW03-13 D/R 4/7 down	06/02/95	45.38	-0.26	-5.73E-03
	10/03/95	41.82	-0.07	-1.67E-03
	07/18/96	45.36	-0.06	-1.32E-03
	12/97	42.78	-0.08	-1.87E-03
	2/98	46.83	0.07	1.495E-03
	7/26/00	44.86	0.05	1.11E-03
	04/18/03	47.37	0.03	6.33E-04
MW03-14 D/R 3/7 down	06/02/95	44.68	0.01	2.24E-04
	10/03/95	40.3	-0.03	-7.44E-04
	07/18/96	44.39	0	0.00E+00
	12/97	41.71	0.07	1.678E-03
	2/98	47.19	0.39	8.264E-03
	7/26/00	45.65	-0.29	-6.35E-03
	04/18/03	47.50	-0.41	-8.63E-03
MW07-32 D/R	11/20/02	68.05	-0.23	-3.38E-03
	03/25/03	67.65	0.08	1.18E-03
MW16-02 R/R2	11/20/02	95.95	1.06	1.10E-02
	03/25/03	97.74	1.31	1.34E-02
MW16-15 R/R2	11/20/02	81.74	-1.44	-1.76E-02
	03/25/03	83.71	-0.83	-9.92E-03
MW16-55 R/R2	11/20/02	119.06	0.06	5.04E-04
	03/25/03	120.24	-0.18	-1.50E-03
MW03-14 R/R2	04/18/03	76.03	-0.47	-6.18E-03

Attachment 2

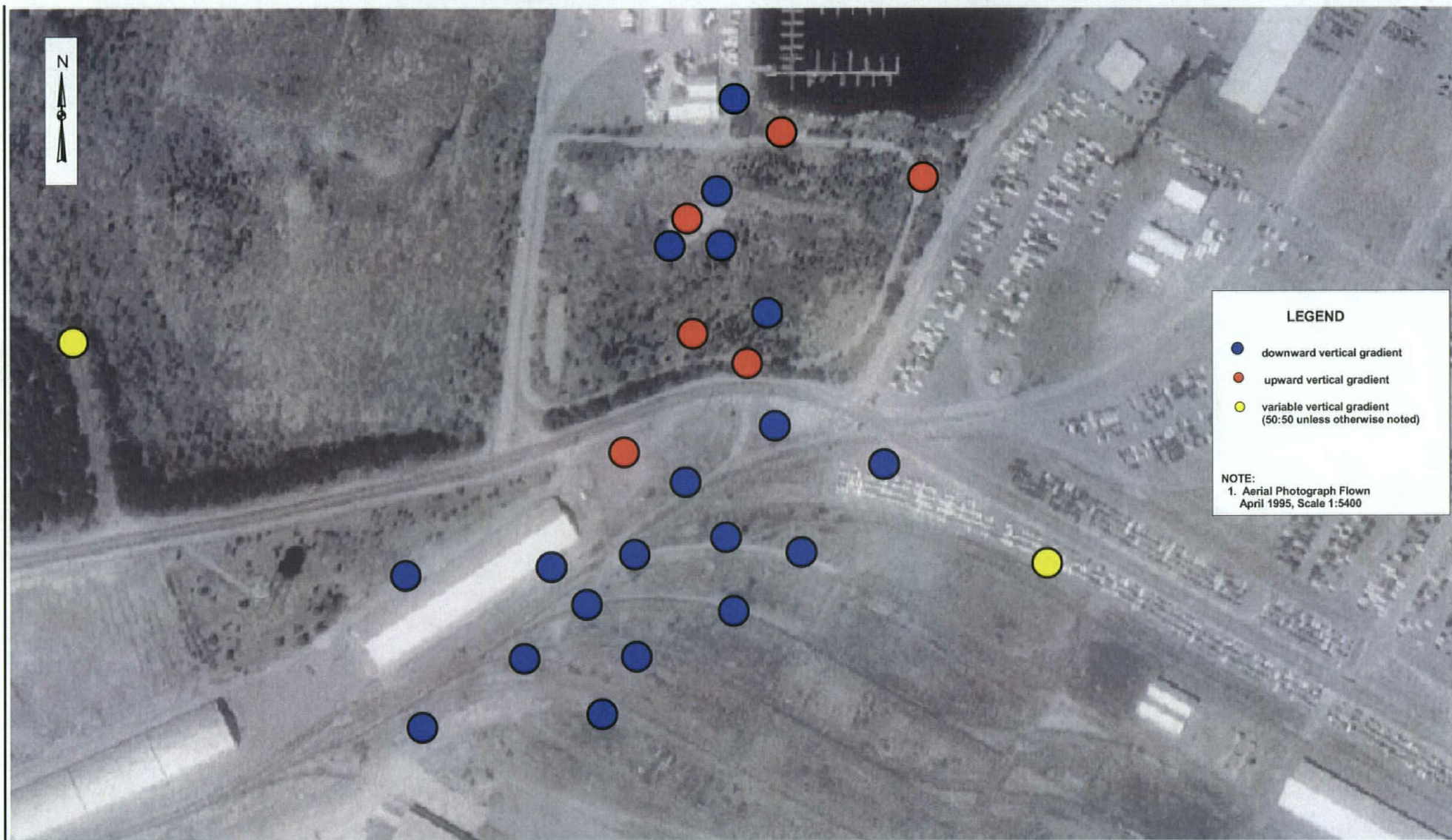


EA ENGINEERING,
SCIENCE, AND
TECHNOLOGY

200 0 200 Feet

EFANE
SITE 16 PHASE II REPORT RTC
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NORTH KINGSTOWN, RHODE ISLAND

SUMMARY OF VERTICAL HYDRAULIC GRADIENTS
BETWEEN SHALLOW (S) AND INTERMEDIATE (I) OVERBURDEN
GW ZONES (DATA FROM REVISED TABLE 3-4;
DRAFT PHASE II REPORT) **FIGURE 1**



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BETWEEN INTERMEDIATE (I) AND DEEP (D) OVERBURDEN
GW ZONES (DATA FROM REVISED TABLE 3-4;
DRAFT PHASE II REPORT)

FIGURE 2



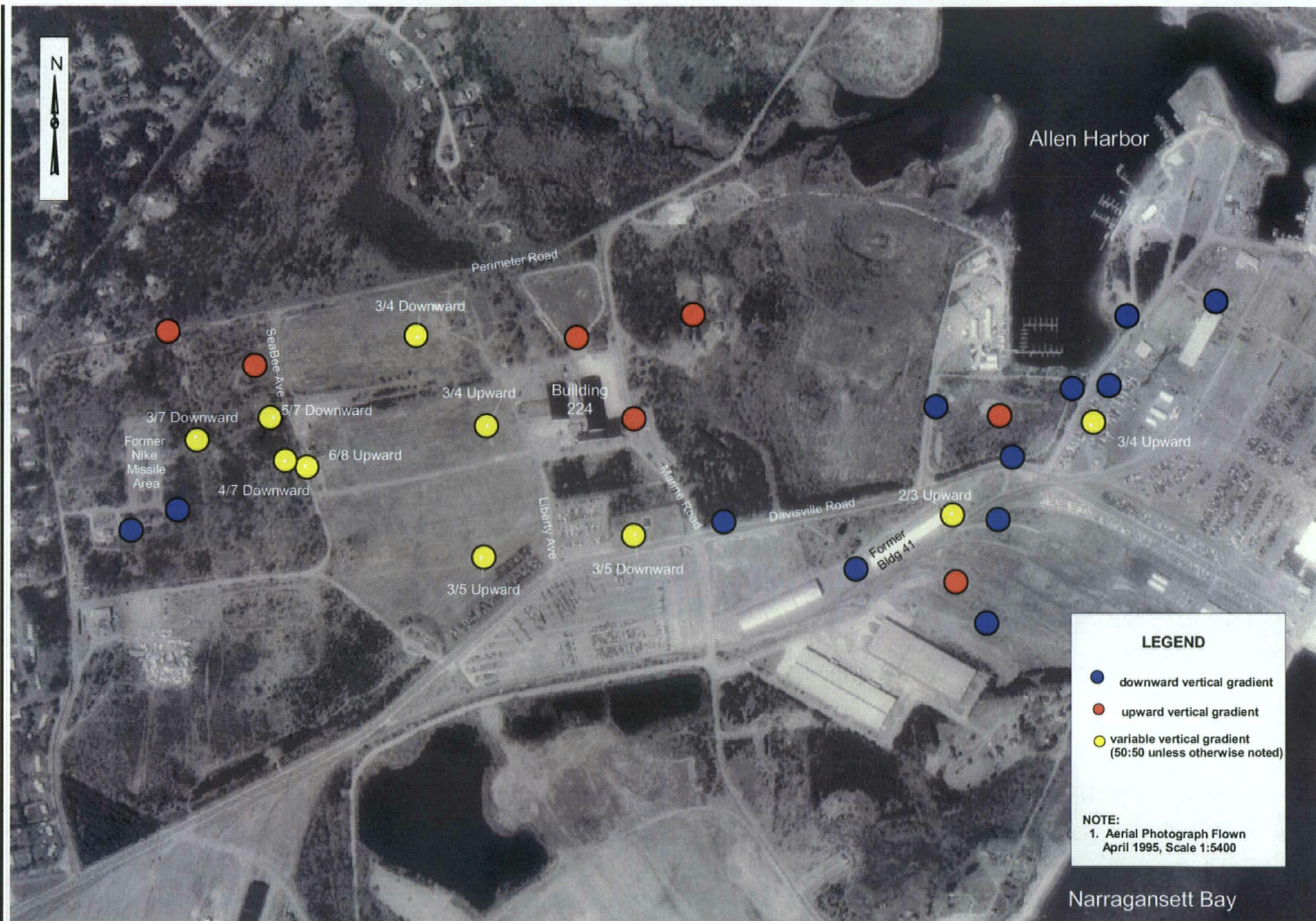
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TECHNOLOGY

600 0 600 Feet

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SUMMARY OF VERTICAL HYDRAULIC GRADIENTS
BETWEEN SHALLOW (S) AND DEEP (D) OVERBURDEN
GW ZONES (DATA FROM REVISED TABLE 3-4;
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FIGURE 3



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200 0 200 400 600 Feet

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SUMMARY OF VERTICAL HYDRAULIC GRADIENTS
BETWEEN DEEP (D) OVERBURDEN TO UPPER BEDROCK (R)
GW ZONES (DATA FROM REVISED TABLE 3-4;
DRAFT PHASE II REPORT)

FIGURE 4



LEGEND

- downward vertical gradient
- upward vertical gradient
- variable vertical gradient (50:50 unless otherwise noted)

NOTE:

1. Aerial Photograph Flown
April 1995, Scale 1:5400

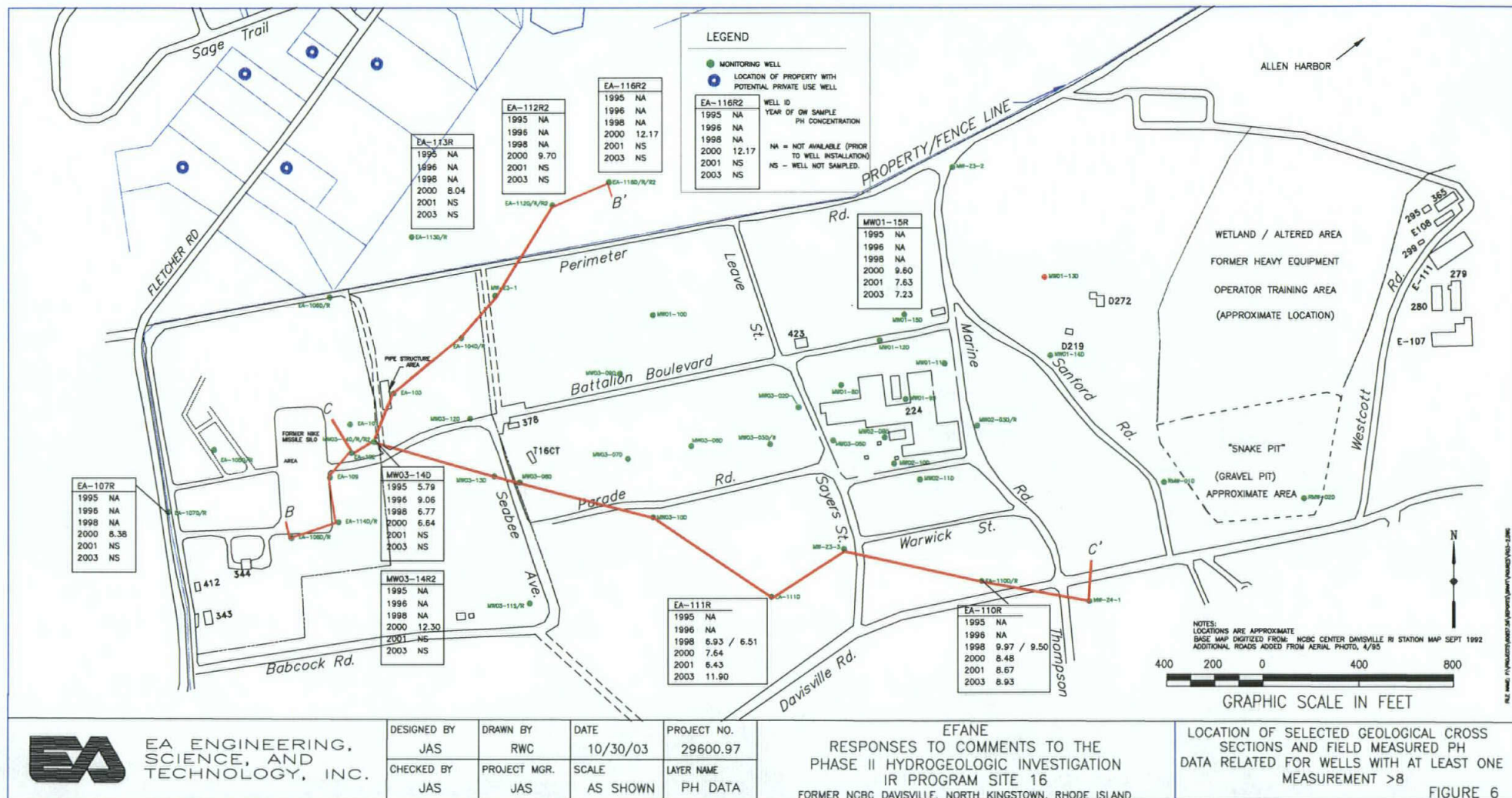


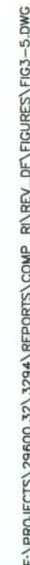
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TECHNOLOGY

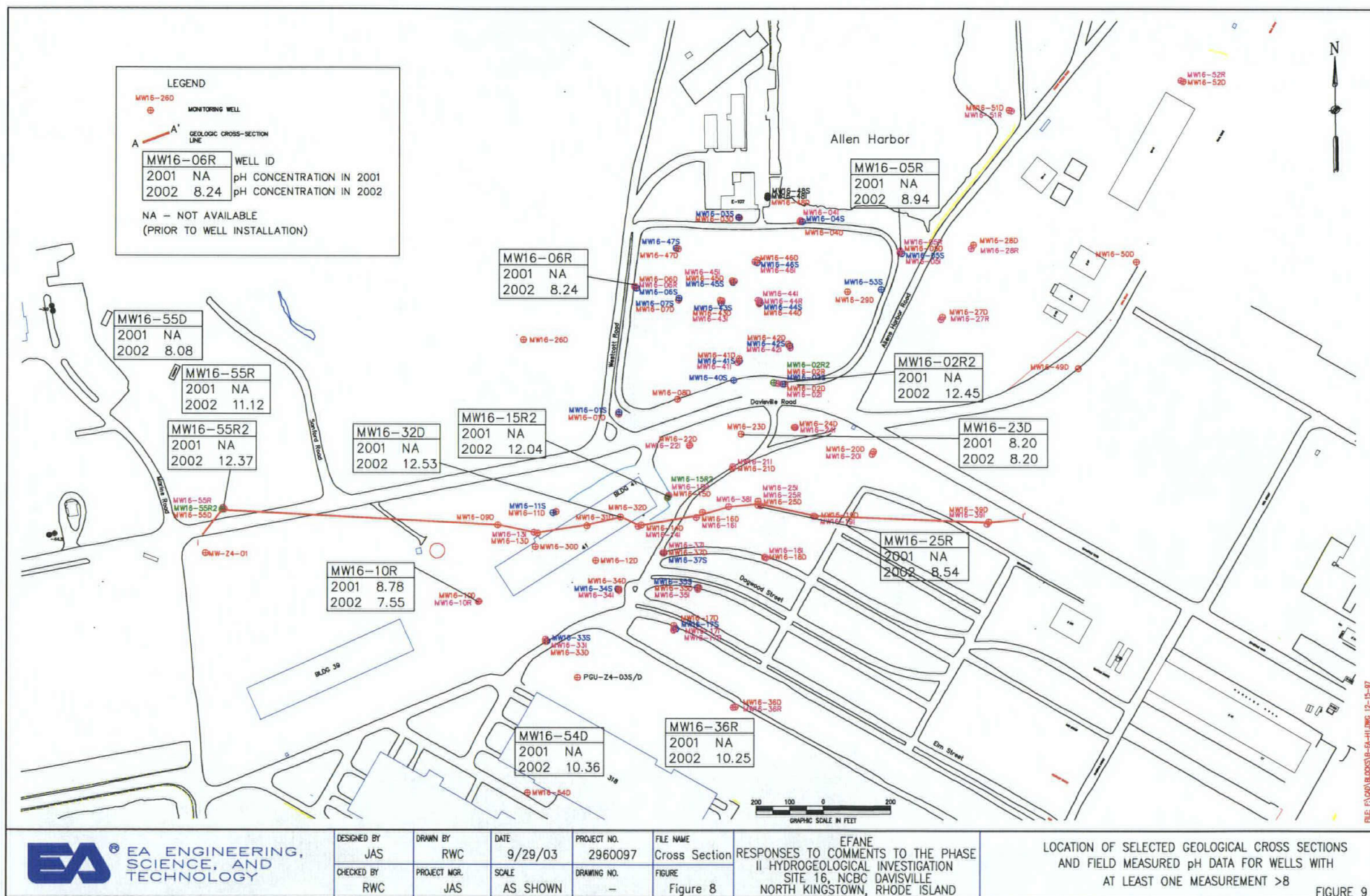
200 0 200 400 600 Feet

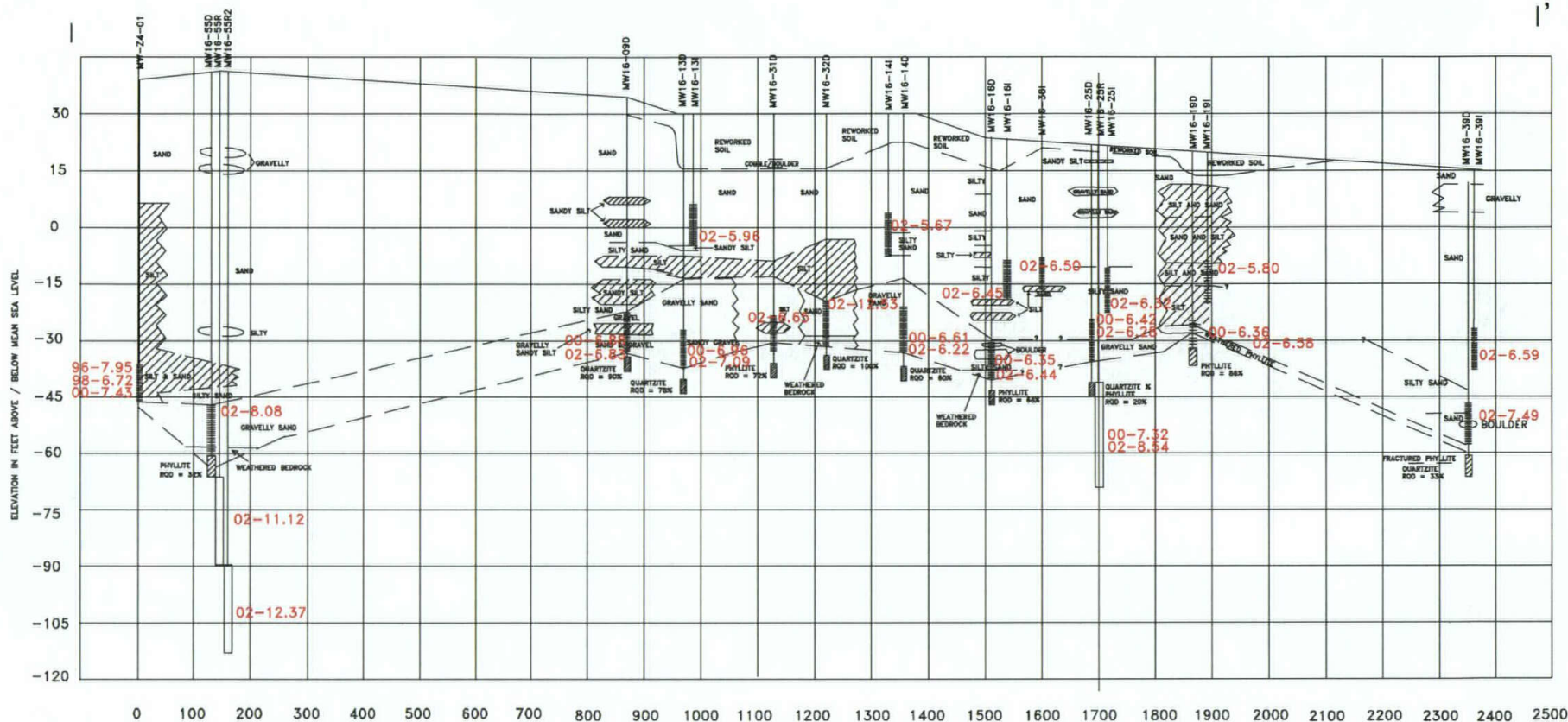
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SUMMARY OF VERTICAL HYDRAULIC GRADIENTS
BETWEEN UPPER BEDROCK (R) TO
DEEPER BEDROCK (R2) GW ZONES
(DATA FROM REVISED TABLE 3-4;
DRAFT PHASE II REPORT) FIGURE 5









EA EA ENGINEERING,
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DESIGNED BY JAS	DRAWN BY RWC	DATE 9/29/03	PROJECT NO. 29600.97
CHECKED BY JAS	PROJECT MGR. JAS	SCALE AS SHOWN	FILE NAME I.I.DWG

EFANE
RESPONSES TO COMMENTS TO THE PHASE II HYDROGEOLOGICAL INVESTIGATION
IR PROGRAM SITE 16
NORC DAVISVILLE, NORTH KINGSTOWN, RHODE ISLAND

GEOLOGIC CROSS SECTION I-I'
AND FIELD MEASURED pH DATA
SAMPLED INTERVALS OF MONITORING WELLS

FIGURE 10